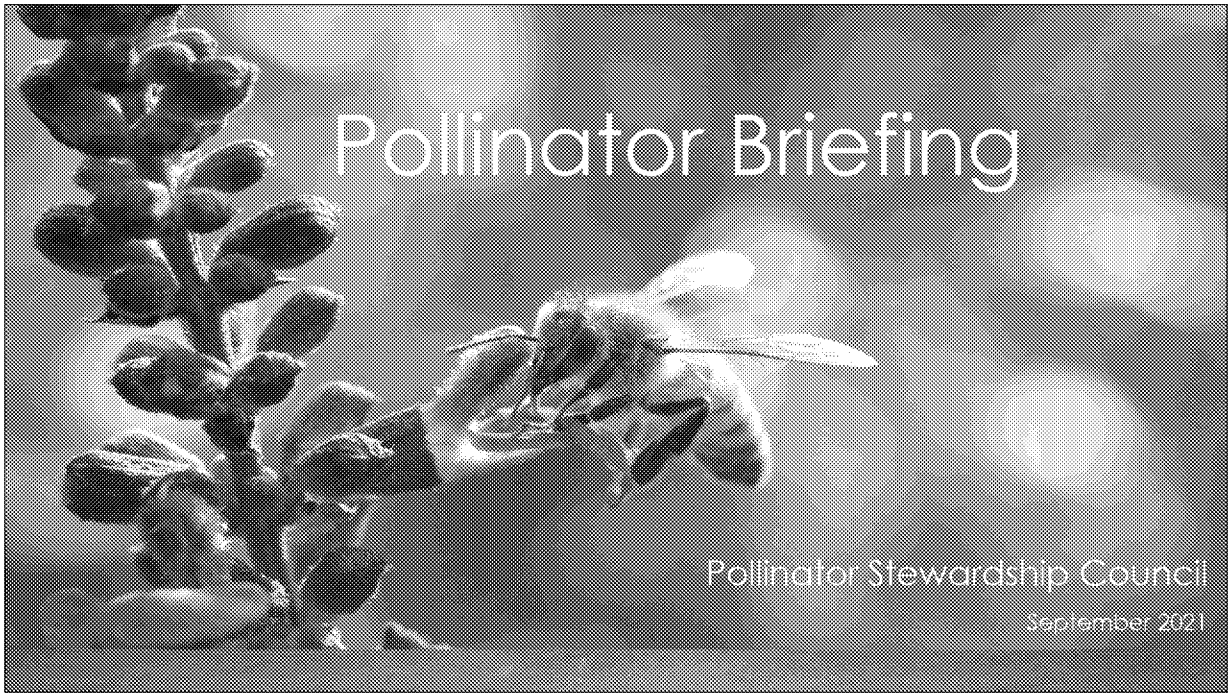

Pollinator Briefing

Pollinator Stewardship Council

September 2021

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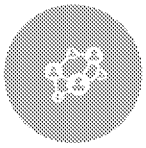
Pollinator Species

Pollinators are insects or animals that transfer pollen from the male anther of one plant to the female stigma of another plant, creating seeds for the next generation of plants

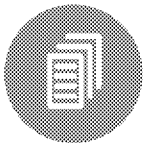
- Most important commercial pollinator species in the U.S. is the European honeybee
  - Honeybees are social organisms that live in colonies above ground
- Wild solitary bees are also important pollinators for many crops
  - Most native bees live in the soil and are solitary
- Other pollinators include bats, birds, and butterflies

Importance of Pollinators



Reproduction

- Majority of plant species **(90%) rely on pollinators to reproduce**



Food Production

- Production of most **vegetables, fruits, nuts, coffee, etc. depend on insect or animal pollinators**
- Grain crops are wind-pollinated

Economy

- Pollinators contribute an estimated **$500 billion to the global economy and an estimated $40 billion to the U.S. economy**
- California's $5.6 billion almond industry requires pollinators
- Honeybees are the most valuable pollinators

Honeybee Declines

KEY OBSERVATIONS

- Honeybee population in the U.S. has dropped from 6 million colonies in the 1940s to 2.8 million today[1]
- The following factors have been associated with honeybee declines:
  - Pesticides
  - Parasites (e.g., Varroa mite)
  - Pathogens (e.g., viruses)
  - Habitat loss
  - Monoculture farming (less diversity in food sources)
- Recent survey of the U.S. bee population shows a 45.5% annual loss for 2020-2021[2]

KEY CAUSES

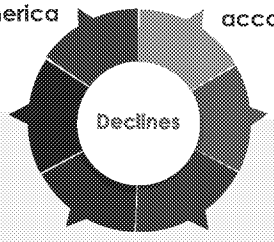
- Pesticide industry believes that Varroa mite is chief cause of bee declines
- Many beekeepers believe that increased use of systemic pesticides (e.g., neonicotinoids) in the 2000's is the major cause of bee declines
  - Beekeepers could manage Varroa mites and viruses before systemic pesticides became the dominant pesticides
  - Most acutely toxic pesticides to bees include neonicotinoids, fipronil, emamectin benzoate, and spinosad
  - Extremely low doses (4-5 nanograms) of neonicotinoids can kill bees

1. [illegible]
2. [illegible]

Systemic Pesticides vs Contact Pesticides

- **Contact pesticides** stay on the outside of the plant
- **Systemic pesticide** characteristics:
  - Move from the treated seed in the soil upward into the plant tissues
  - Contaminate the nectar, pollen, leaves, and fruit of the plant
  - Oral route of exposure
  - Mobile and extremely persistent in water and soil
  - Accumulate in soil and frequently found in water bodies as a result of runoff from treated fields and residential/commercial areas
  - Extremely hazardous to pollinators at low doses
  - Mammals, birds, aquatic organisms are also adversely affected, including human neurological injuries
  - Recent studies in the US corroborate Dutch scientist Henke Tennekes assertion that low dose exposure over time is just as deadly as high dose exposure all at once
- **Pollinator Stewardship Council is calling for a ban on the systemic neonicotinoids**

Pollinator Declines



Largest honeybee losses are in Europe and North America

Honeybee loss data for Asia and Africa are not reliable according to FAO

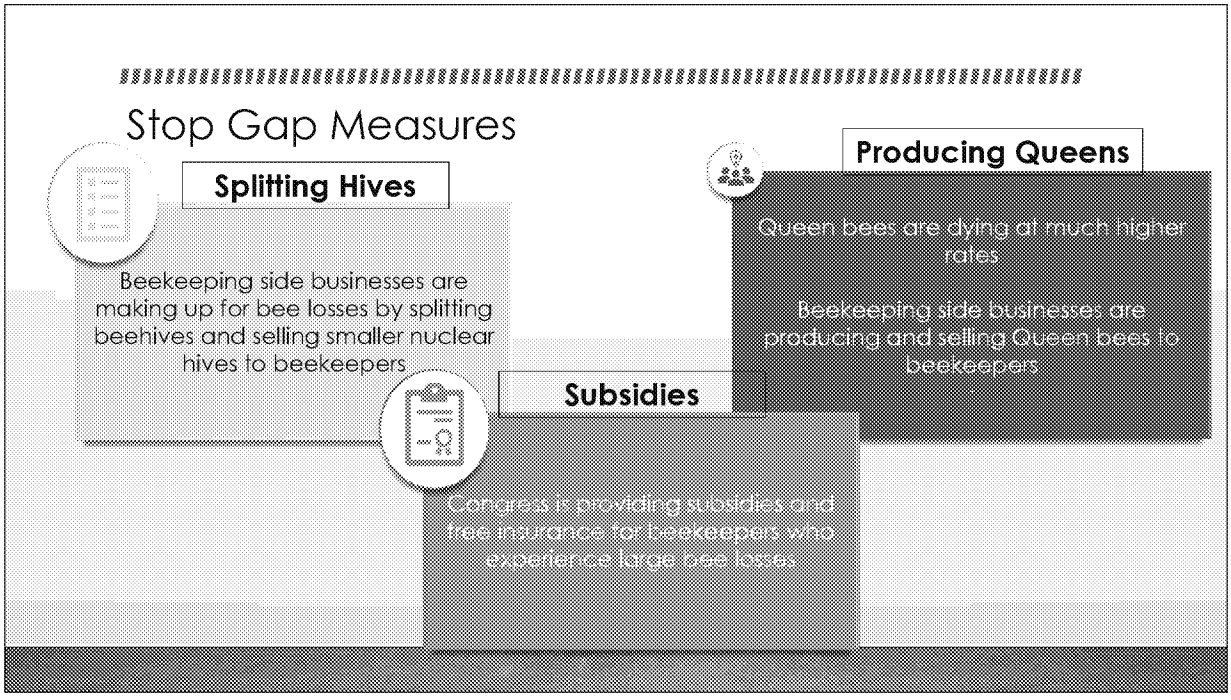
Newer systemic pesticides (diamides and keto-enols) are designed to kill immature lepidoptera (e.g., butterfly larvae)

Losses for the thousands of native, solitary bee species are not well documented

Eastern monarch butterfly populations have declined 80-90% in the last 40 years

Western monarch butterfly populations have declined 99% in the last 40 years

- In 2015, EPA issued an approach for identifying options for protecting monarch butterflies, which focused on the impact of pesticides on milkweed plants https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0382-0002


Stop Gap Measures
Splitting Hives
Beekeeping side businesses are making up for bee losses by splitting beehives and selling smaller nuclear hives to beekeepers
Producing Queens
Queen bees are dying at much higher rates
Beekeeping side businesses are producing and selling Queen bees to beekeepers
Subsidies
Congress is providing subsidies and free insurance for beekeepers who experience large bee losses

High Colony Death Rates Are Unsustainable

Bee Health

- Colonies that are split are getting weaker and do not pollinate crops as well as earlier bee colonies
  - Implications for food security and affordability
- Bee death rates are getting progressively higher with 45.5% loss of bees in 2021

Generic Diversity

- Genetic diversity of U.S. bees are likely decreasing, making bees more vulnerable to climate change and disease

Yields of Honey & Crops

- Yields of honey per hive in the U.S. has decreased 36% from 2000 – 2018 according to USDA data
- Crop yields for apples, cherries, and blueberries are being reduced by a lack of pollinators[1]

Honey

- 75% of honey in the U.S. was imported from other countries in 2018 [2]
- FDA does not monitor pesticides in honey as EPA has not developed tolerances for most pesticides in honey

U.S. Pesticide Laws

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

- Authorizes EPA to protect human health and the environment, not growers and pesticide companies
- Governs regulation, distribution, sale, and use of pesticides
- Allows pesticide companies to generate safety data for their own products (inherent conflict of interest)
- Risk-benefit statute:
  - EPA assesses risks of pesticides to non-target organisms (e.g., humans, aquatic organisms, birds, mammals, bees) and the environment
  - Benefit assessments include biological benefits and economic analyses; does not include loss of ecosystem services (e.g., pollination, beneficial predators, soil organisms)
- Allows conditional registration without a complete database
  - Majority of pesticides were approved without adequate bee studies

U.S. Pesticide Laws (Con't)

Federal Food, Drug, and Cosmetic Act (FFDCA)

- Authorizes EPA to establish maximum pesticide residue levels (tolerances) that are allowed in food or feed

Food Quality Protection Act (FQPA)

- Amended FIFRA and FFDCA
- Established more stringent safety standards for pesticide residues and strengthened human health protections

Endangered Species Act (ESA)

- Designed to protect endangered and threatened species and their habitat
- Only eight out of 4,000 bee species in the U.S. have been placed on endangered species list

EPA's Risk Assessment Process for Bees

Prior to 2012, there was no risk assessment process for bees

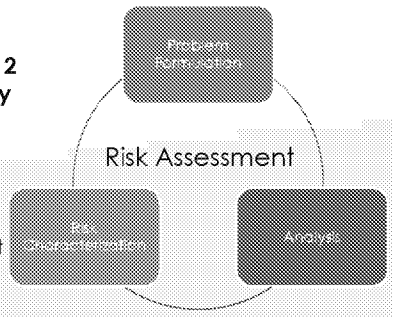
EPA's risk assessment process for pollinators developed in 2012 at a SETAC workshop hosted by EPA and the pesticide industry

- EPA and the pesticide industry later published a book on EPA's pesticide risk assessment process for pollinators

EPA's risk assessment guidance published in 2014

- Guidance identified three tiers of toxicity studies needed for assessing risk to individual honeybees and honeybee colonies that live in hives above the ground
- Guidance assumes that one species of honeybees can represent the thousands of native, solitary bee species that mostly live in the soil

Guidance for EPA risk assessors who characterize risks to bees published in 2016



EPA's Risk Assessment Process for Bees (Con't)

- Most registered pesticides do not have acceptable or sufficient toxicity and exposure data to assess risk to bees
- Bee studies have certain drawbacks:
  - Laboratory studies with individual bees may not reflect real world field experience for bees that live in colonies
  - Semi-field studies include tunnel studies and glucose feeding studies
    - Chronic risk assessments for neonicotinoids depend largely on one semi-field glucose feeding study/neonicotinoid
  - Field and semi-field studies with bee colonies have many variables that are difficult to control (e,g., cross contamination between controls and treated plants)

Risk Assessment and Decision-Making Process for Bees

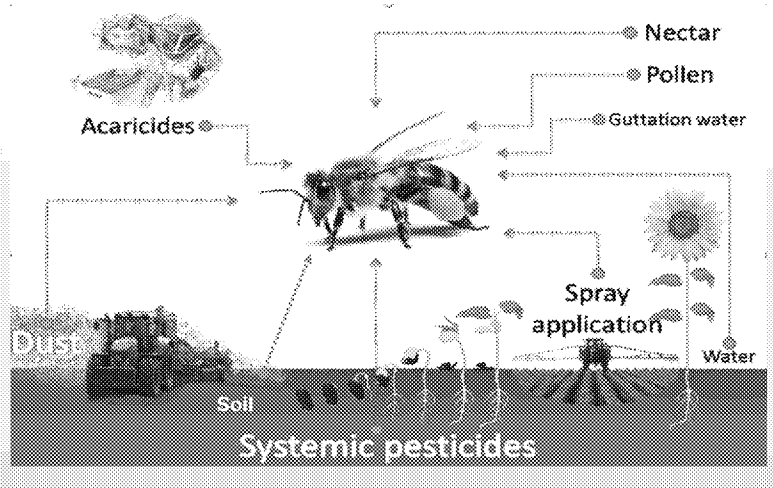
U.S. Risk/Decision Process for Bees

- EPA only **assesses risk to one species** of honeybees
- EPA's risk assessments only evaluate exposure of bees to **pesticides in nectar and pollen**
- EPA operates under the **Data Quality Act**, which requires a high, sometimes unattainable, degree of certainty before taking action

European Risk/Decision Process for Bees

- European Union assesses risk to **three groups of bees:** honeybees, bumble bees, and solitary bees
- European risk assessments evaluate **additional exposure routes (e.g., water, dust from abraded seed during planting)**
- European Union operates under the **Precautionary Principle** to prevent risks before it is too late and does not require absolute certainty

Exposure Routes for Bees



EPA Actions to Protect Pollinators

- EPA relies mostly on **non-regulatory actions** to protect honeybees
  - Warning statements on pesticide labels concerning toxicity of pesticides to bees
  - Voluntary best management practices
  - Restricting the time of pesticide application to blooming crops
  - Relying on growers to notify beekeepers before they spray
  - Fines are not assessed by state agencies when pesticide use results in pollinator injury and death
- EPA has not implemented actions to protect native bees, butterflies, and other pollinators from exposure to pesticides

Congressional Action on Pollinators

2007 - 2008

Early Congressional hearings focused on causes of Colony Collapse Disorder (CCD)

- Congress provided USDA with millions of dollars to identify causes of CCD
- Most research money was spent on factors other than pesticides
- USDA concluded that several factors were responsible for bee declines

2014

Later Congressional hearing focused on Varroa mite as the cause of bee declines

2013 - Present

Rep Neguse and Rep Blumenauer have sponsored bills to save pollinators and to ban toxic pesticides that harm children, workers and consumers

2014 - Present

Congress provided free insurance and subsidies for beekeepers' losses

Pollinator Research

Industry-Directed Research Results Differ from Independent Research Results

Industry-Directed and USDA Research

- **Industry-generated bee studies** show little to no impact of pesticides on honeybees
- **Academic-generated bee studies funded by the pesticide industry** show little to no impact of pesticides on honeybees
- Majority of **USDA-funded research** ($200 million) focused on the impact of factors other than pesticides to honeybees
- EPA's risk assessments are based on industry-generated studies (little to no independent verification)

Independent Research

- **Numerous independent research studies examined impact of pesticides on bees**
  - Vast majority indicated adverse effects of pesticides to honeybees and honeybee colonies
  - Most independent studies produced in Europe and Canada
  - European Union banned three neonicotinoids based on research showing high risk to bees
  - Ontario government conducted field monitoring studies showing risk to bees from exposure to neonicotinoids

Research Studies on Systemic Pesticides

- **Worldwide Integrated Assessment of Systemic Pesticides** [1]
  - Conducted by experts around the world
  - Examined 1,100 published research studies for systemic pesticides and non-target organisms
  - Concluded that systemic pesticides (e.g., neonicotinoids and fipronil) were causing adverse impacts to a wide range of organisms, including pollinators

[1] http://www.tandfonline.com/doi/abs/10.1080/10807039.2014.950291

Pollinator Strategies

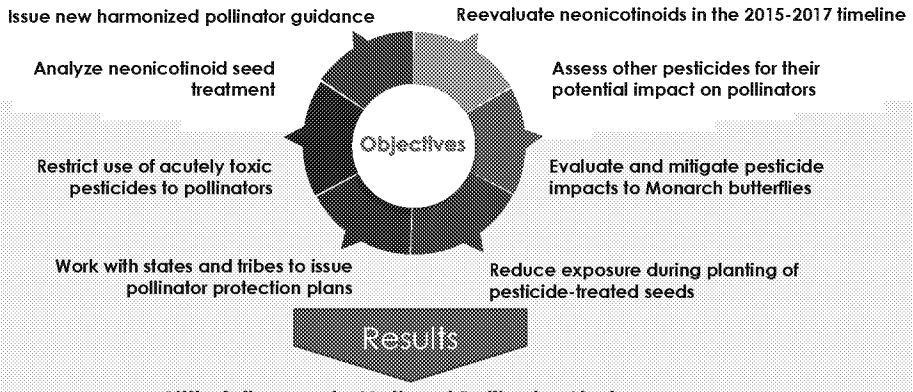
U.S. National Strategy

- In 2015, an interagency group of representatives from 16 federal agencies developed a national strategy for promoting the health of bees and other pollinators [1]
- Goals of the strategy included:
  - Reduce honeybee losses to no more than 15% by 2025
  - Increase monarch butterfly population
  - Retain/enhance habitat for pollinators

CropLife America Strategy

- Game plan for advancing the pesticide industry interests for pollinators includes:
  - Working closely with EPA and USDA decision makers to influence pollinator activities [2]
  - Addressing Congressional and state concerns
  - Helping design and support scientific and research studies and strategies for pollinators that emphasize Varroa mites, viruses, and bee nutrition
  - Shaping the conversation on pollinators in the media
  - Promoting voluntary best management practices for state and EPA mitigation measures
  - Exploring speaking opportunities at meetings and workshops
  - Monitoring legal activities

U.S. National Pollinator Strategy Objectives and Results



Little follow-up to National Pollinator Strategy

How to Save Our Pollinators

- Work with Congressional Members to:
  - Strengthen pesticide laws
  - Lessen the influence of pesticide companies and growers on EPA's decisions
  - Support bills for saving pollinators (Rep. Neguse and Rep. Blumenauer)
  - Change House oversight committee to Natural Resources Committee
- Develop rigorous risk assessment procedures and guidance that includes:
  - Exposure routes not currently assessed:
    - Water
    - Dust from abraded pesticide-treated seed during planting
    - Contaminated soil
  - Time-cumulative toxicity for pesticides that accumulate over time (e.g., neonicotinoids)
  - Relating sublethal effects to definitive endpoints (mortality, growth, and reproductive effects)
  - Risk to native solitary bees
  - Risk to butterflies

How to Save Our Pollinators (Con't)

- Develop effective risk mitigation measures:
  - Go beyond voluntary best management practices
  - Avoid dependence on pesticide label warning statements and precautionary statements
  - Avoid dependence on ineffective vegetative buffer strips that are not enforced
  - Restrict the use of bee-toxic pesticides
- Develop strong pesticide enforcement and monitoring programs
  - Currently state agricultural agencies have primary enforcement responsibility
  - Propose giving state enforcement responsibility to state natural resource agencies
- Encourage the use of Integrated Pest Management strategies
- Provide the public with easily accessible fact sheets for individual pesticides
  - Documents in regulations.gov cannot be accessed through search engines (e.g., Google)
  - EPA issued pesticide fact sheets in the past
- Minimize prophylactic use of pesticides as an insurance policy
- Codify additional data requirements for bees in the Code of Federal Regulations (40 CFR Part 158)
- Create an advocate and expert on honeybee toxicology in EPA who can help the bee industry
- Repeal treated article exemption for regulating pesticide seed treatment

Acute Toxicity of Pesticides to Adult Honey Bees

(Based on U.S. EPA's and European Risk Assessments)[1]

Pesticide	Oral acute toxicity 48-hr LD50 (ug a.i./bee)	Contact acute toxicity 48-hr LD50 (ug a.i./bee)	Systemic Pesticide
Spinosad		0.0029	yes
Emamectin benzoate		0.0035	yes
Fipronil	0.0042	0.0059	yes
Thiamethoxam	0.005	0.024	yes
Clothianidin	0.0038	0.044	yes
Imidacloprid	0.0038	0.078	yes
Dinotefuran	0.023 – 0.0076	0.047	yes
Bifenthrin		0.0146	no
Esfenvalerate		0.0172	no
Pyrethrins		0.022	no
Cypermethrin	0.17	0.023	no
Permethrin	0.13-0.19	0.024	no
Cyfluthrin		0.037	no
Lambda cyhalothrin	0.96	0.038	no
Dimethoate		0.05	yes
Azinphos-methyl	0.15	0.063	no
Resmethrin		0.063	no
Oxamyl	0.094	0.31	yes
Chlorantraniliprole	>0.027	>0.125	yes
Fenpropathrin		0.1 (24-hr – formulated product)	no

1. These rankings do not include chronic toxicity to bees or toxicity to brood or larvae. Several pesticides, which include spirotetramat, spirodiclofen, and spiromesifen, have been shown to cause effects on brood.

Acute Toxicity of Pesticides to Adult Honey Bees (Con't)

(Based on U.S. EPA's and European Risk Assessments)[1]

Pesticide	Oral acute toxicity 48-hr LD50 (ug a.i./bee)	Contact acute toxicity 48-hr LD50 (ug a.i./bee)	Systemic Pesticide
Phosmet	4.0 (24 hr)	0.1 -1.06	yes
Chlorpyrifos	0.12	0.11	no
Carbofuran		0.16	yes
Sulfoxaflor	0.146	0.379 (72 hr)	yes
Methomyl	0.28	0.16	yes
Ethyl parathion		0.175	no
Methyl parathion [2]		0.11- 0.21	no
Fluvalinate		0.2	no
Malathion	0.38	0.27	no
Aldicarb		0.28	yes
Rotenone		0.24 - 60	yes
Phorate		0.32	yes
Diazinon	0.2 (24 hr)	0.37	no
Methiocarb		0.375	no
Fenvalerate		0.41	no
Abamectin		0.41	yes
Naled		0.48	no
DDVP (Dichlorvos)	0.29	0.495	yes
Carbaryl	0.1-0.5	1.1-1.3	yes
Acephate		1.2	yes

1. These rankings do not include chronic toxicity to bees or toxicity to brood or larvae. Relevant pesticides, which include spirotetramat, spirodiclofen, and spiromesifen have been shown to cause effects on brood.
2. The encapsulated form of parathion (Penncap) is extremely toxic to bees.

Acute Toxicity of Pesticides to Adult Honey Bees (Con't)

(Based on U.S. EPA's and European Risk Assessments)[1]

Pesticide	Oral acute toxicity 48-hr LD50 (ug a.i./bee)	Contact acute toxicity 48-hr LD50 (ug a.i./bee)	Systemic Pesticide
Propoxur		1.35	no
Methamidophos		1.37	yes
Tetrachlorvinphos		1.4	no
Azadirachtin		2.5 (formulated product)	yes
Oxydemeton, methyl		3.0	yes
Disulfoton		4.1 (24 hr)	yes
Terbufos	4.1		yes
Endosulfan	1.9 (24 hr)	4.5	no
Ethoprop		2.5-5.6 (96-hr)	no
Bifenzate		7.8	no
Acetamiprid	15.1	8.1	yes
Piperonyl butoxide		11	no
Dicofol		12.2	no
Propargite		15	no
Fenpyroximate		15.8	no
Coumaphos		20.3 (24-hr)	yes
Thiodicarb		25	no
Cyromazine		25	yes
Petroleum distillates		25	yes
Thiacloprid	12.8	43.6	yes

1 These rankings do not include chronic toxicity to bees or toxicity to brood or larvae. [illegible] pesticides, which include [illegible], have been shown to cause effects on brood.

Acute Toxicity of Pesticides to Adult Honey Bees (Con't)

(Based on U.S. EPA's and European Risk Assessments)[1]

Pesticide	Oral acute toxicity 48-hr LD50 (ug a.i./bee)	Contact acute toxicity 48-hr LD50 (ug a.i./bee)	Systemic Pesticide
Indoxacarb	133-296	0.18 - 400	no
Pymetrazine	117	200	yes
Tebufenozide		234 (96-hr)	yes

1. These rankings do not include chronic toxicity to bees or toxicity to brood or larvae. [illegible] pesticides, which include spirotetramat, spirodiclofen and spiromesifen, have been shown to cause effects on brood.